

National Air & Space Model (NASM)

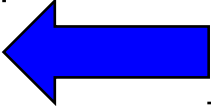


C2 MODELING AND SIMULATION SYMPOSIUM

28 April 1999

Agenda

JSIMS

- Background 
- System concept
- Schedule
- Demonstration description
- Demonstration
- Q&A

What JSIMS Is

JSIMS

- A program to meet Joint and Service M&S requirements through the
 - Leveraging of Service M&S programs to develop a single JSIMS system
 - Establishment of Enterprise-wide standards and the central management of requirements
 - Development of “seamless” integration
 - Initial focus is on Joint requirements and use
- JSIMS Enterprise will provide to the Air Force
 - completion of non-AF A&S functionality
 - Land, Maritime, Joint and other combat functionality
 - “Core” and “Common Services”

What NASM Is

JSIMS

- The Air Force's portion of the Air and Space (A&S) domain of the Joint Simulation System (JSIMS)
 - Participate in the overall management of the JSIMS Enterprise
 - Participate in the Knowledge Acquisition and Validation of items the AF owns in the real world
 - Design, develop, test and deliver Mission Space Objects (MSO) of current AF and Foreign systems (aircraft, missiles, satellites, C2 systems)
 - Assist other Services in their development of their A&S MSO
 - Participate with the other Services in their development of non-USAF A&S MSOs
- NASM as a contractual vehicle will ensure that JSIMS satisfies Air Force Title X Responsibility

History

JSIMS

**NASM Has Evolved Significantly
and Is No Longer Simply a
Replacement for the Air Force's
Air Combat Model**

JSIMS A&S 1995/96

NASM Evolved Into
JSIMS A&S As a Result
of the Services
Agreeing to the JSIMS
MOA

NASM 1995

NASM Resulted From the AF's Plans to
Accurately Represent Aerospace in All
Service Models

JFAM 1994

FAM Resulted From AF Coordination With
Army and Navy to Eliminate
Development Overlap in Planned Next
Generation Models

FAM 1993

Future Air Model (FAM) Was Originally Strictly the
Air Combat Model Replacement As Planned for by
the AWSIM CCB

JSIMS Related Organizations

JSIMS

- Joint War Fighting Center (JWFC)
 - JSIMS Requirements Manager - Consolidates and Coordinates Requirements for JSIMS
- JSIMS Joint Program Office
 - Enterprise-Wide Management
 - Integration and Development (I&D) Program and Contract Management
- TRW
 - JSIMS I&D Contractor (Standards Development, Common Services Development, Joint Model Development)
- Other DA and DA contractor partners

NASM Related Organizations

JSIMS

- USAF/XOCA
 - Provides NASM Program Direction and Resources
 - JSIMS A&S Executive Agent (EA) Representing USAF's Requirements/Overall Program Management to JSIMS
- Air Force Agency for Modeling and Simulation (AFAMS)
 - Liaison between NASM / JSIMS and USAF Users for USAF Modeling and Simulation Requirements
 - Identifies Subject Matter Experts (SME) and Authoritative Data Sources

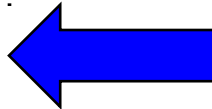
NASM Related Organizations

JSIMS

- Electronic Systems Center
 - NASM Program/Contract Management
 - JSIMS A&S Development Agent (DA)
- Raytheon
 - NASM Technical Implementation and Software Development (Prime Contractor)

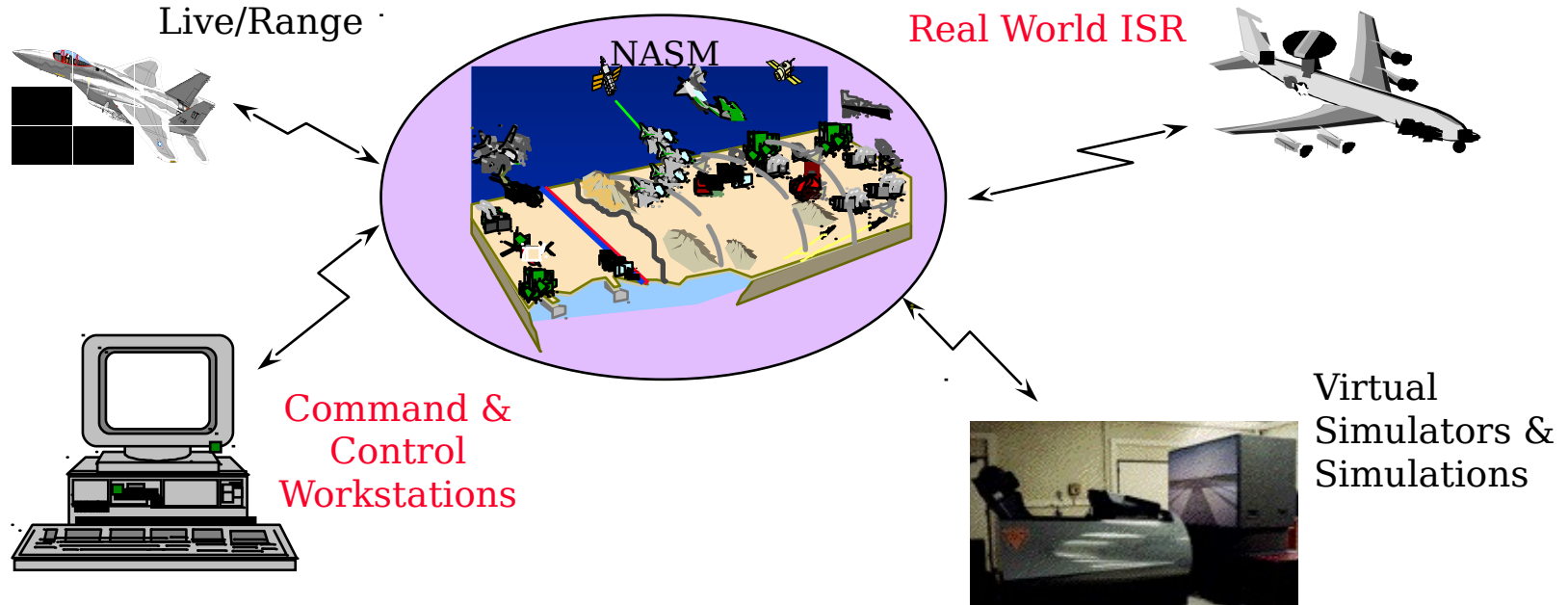
Agenda

JSIMS

- Background
- System concept 
- Schedule
- Demonstration description
- Demonstration
- Q&A

NASM

JSIMS



- Simulation that realistically represents full range of aerospace power in Air Force and Joint Operational Readiness exercises
- Provide effective battlestaff training from Wing and up
- Capability for distributed collaborative exercises

is on tailoring inputs to C2 equipment and operators. Level of realism for conflict outcome necessarily sufficient for course of action assessment

Joint Universal Capabilities List

JSIMS

Joint Training

J1 CINC/JTF
J2 Supporting CINC
J3 CINC/JTF with Comp
J4 JFLCC
J5 JFACC
J6 JFMCC
J7 JIC
J8 JIC & JISE
J9 JSOCC

Marine Corps Training

**M1 Marine Expeditionary
Force (MEU)**
**M2 MARFOR Training and
Planning**
M3 MEU (SOC)
M4 Amphibious Operations

Army Training

A1 Corps
A2 Corps and Division
A3 Division
A4 Brigade or Battalion
A5 Logistics
A6 Intelligence

Navy Training

N1 Fleet Commander
N2 Carrier BG Commander
N3 Task Group Commander
N4 Warfare Commander

Air Force Training

F1 AFFOR
F2 JFACC and JAOC
F3 Wing Ops Centers

Other JSIMS Applications

O1 Planning and Analysis
**O2 Crew/Team Mission
Rehearsal**
O3 Senior Officer Education
**O4 Professional Military
Education**
O5 Doctrine Development

IOC Capabilities

JSIMS

- Level of resolution driven by:
 - Interface of synthetic battlefield to Training Audiences
 - ◆ Real C4I
 - ◆ Role Players with automation
 - Credibility of representations
- For JUCL J3, provide for only a single level of resolution
 - Design should allow subsequent selectable levels of resolution
- Foreign representations by “parameterization”
 - Behaviors not unique
 - Gray Force data availability is an issue

IOC Capabilities

JSIMS

- Kinematics/Motion
 - 3DOF
 - Account for heading, speed, rate of turn, and climb/dive rates
 - Routes, Points of Intended Movement, Station, Orbit
- Damage Assignment
 - Model damage states (operational, not operational but repairable, etc)
 - Model collateral damage for complex entities
 - Allow adjudication by target, shooter or 3rd party
 - Use Joint Munitions Effectiveness Manual
- Damage Assessment
 - Determination by an observer of the apparent damage to an entity?
 - Dependent on environment and observer/sensor capability

IOC Capabilities

JSIMS

- Air Platforms
 - Represented as individual aircraft or flights of aircraft
 - Maintenance at the individual aircraft level
 - Flight Operations
 - ◆ ATO implementation at various levels of automation
 - ◆ Missions generated automatically (low fidelity) from either real or simulated ATO and ACO
 - Launch and recovery depend on runway availability, etc
 - Diversion of aircraft to an alternative base/ship
 - Aircraft entities reflect
 - ◆ Weight limitations
 - ◆ Loading from stores
 - ◆ Loads appropriate to the aircraft
 - ◆ Cargo capacity
 - Fuel consumption for fixed wing depends on type, speed, altitude and aircraft configuration (bomb load)

IOC Capabilities

JSIMS

- Organizations
 - Training audience organizations represented in simulation as an observable, locatable, attritable entity
 - Individual aircraft can be organized into flights, and flights into packages
- Logistics
 - Entities consume fuel, weapons, ammunition, expendables (chaff, flares), consumables (food, water)
 - Air to air refueling provided
 - Airbases store consumables and expendables
- Airbases:
 - Runways, taxiways
 - Maximum on Ground for aircraft
 - Sortie generation rates
 - Off-load/on-load rates of cargo to/from airbase
 - Aircraft maintenance operations

IOC Capabilities

JSIMS

- Weapons at 2 levels of resolution
 - Explicit: Weapons can be detected, intercepted, and engaged
 - Implicit: Only the effects are represented
- Weapons types:
 - Missiles
 - Close in Weapons Systems
 - Guns
 - Torpedoes
 - Mines
- Environment
- Flight Plans
- Communications

IOC Capabilities

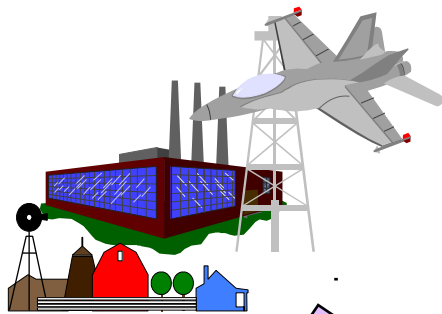
JSIMS

- Sensors
 - Radar
 - IR
 - Visual
 - IMINT
 - SIGINT/ESM
 - Sonar
 - IFF
- Countermeasures
- Tracking and Correlation
- Navigation
- Flight Behavior
- Space
- Civil Environment

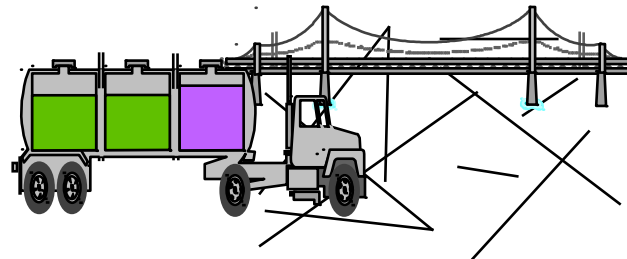
Civil Environment Design

JSIMS

- Input-Output Economic Model

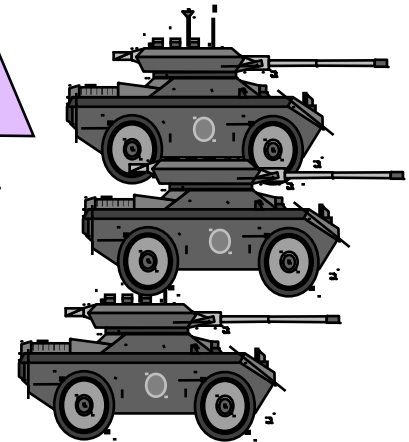


**Attacks on
Factories &
Other
Production
Facilities**



**Attacks on
Transportation
Network for FOOD,
FUEL, AMMO, SPARE
PARTS:
Constrain Red's
transshipment problem**

**Effects on
End User
(Red Ground,
Air, Naval
Forces)**



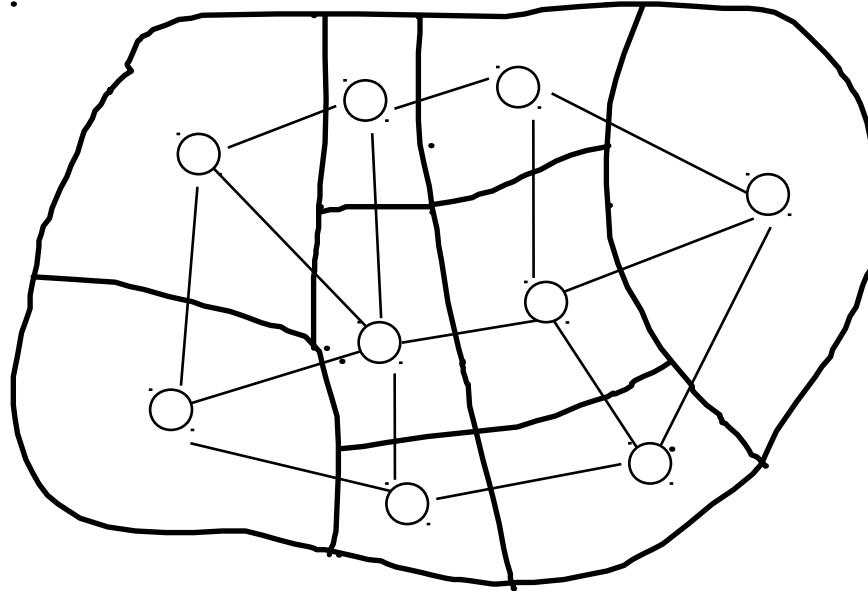
**I/O Economic
Model**

**A: Intermediate
demand matrix**

**B: Capital
input
matrix**

Civil Environment Design

JSIMS

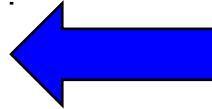


- A very simple aggregate network could be used at first (e.g. as many transportation nodes as there are sub-regions), with possible extension to more detailed models later. This is a scenario-design issue, not an architectural one.
- Civil Environment would track the transportation, storage, and production facilities in each region, and sum it up to the corresponding nodes and/or links

Agenda

JSIMS

- Background
- System concept
- Schedule
- Demonstration description
- Demonstration
- Q&A



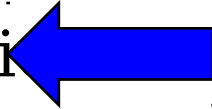
A&S Schedule Overview

JSIMS

- 1.0 (JSIMS IOC), Apr 01
 - Primarily Joint training (Functional Capability (FC) J3)
- 1.1 Dec 01
 - Incorporates Army Ground Combat Other (GCO), (a.k.a. “WARSIM Lite”)
 - Possible support to some focused exercise events
- 1.2 (Air Force Transition), Dec 02
 - Supports AF Primary Exercise fielding (FC F1/F2)
 - Interface to Virtual Simulator(s)
- 2.0 (JSIMS FOC), Dec 03
- 2.1 Dec 04
 - Wing Operations Center training (FC F3)
 - Automation above WOC & higher fidelity

Agenda

JSIMS

- Background
- System concept
- Schedule
- Demonstration description 
- Demonstration
- Q&A

Demonstration Description

JSIMS

- Prototype Objectives
- Prototype Activities
- Prototype Overview
- Results
- Demonstration Overview

Prototype Objectives

JSIMS

- Assess architecture risk areas:
 - Multi-Resolution Models (MRM)
 - Composition based Models
- Assess simulation engines
- Assess other areas
 - Initialization
 - Behavior
 - Interactions through FOs
 - Stress architecture under load
 - Create developer test environment

Prototype Activities

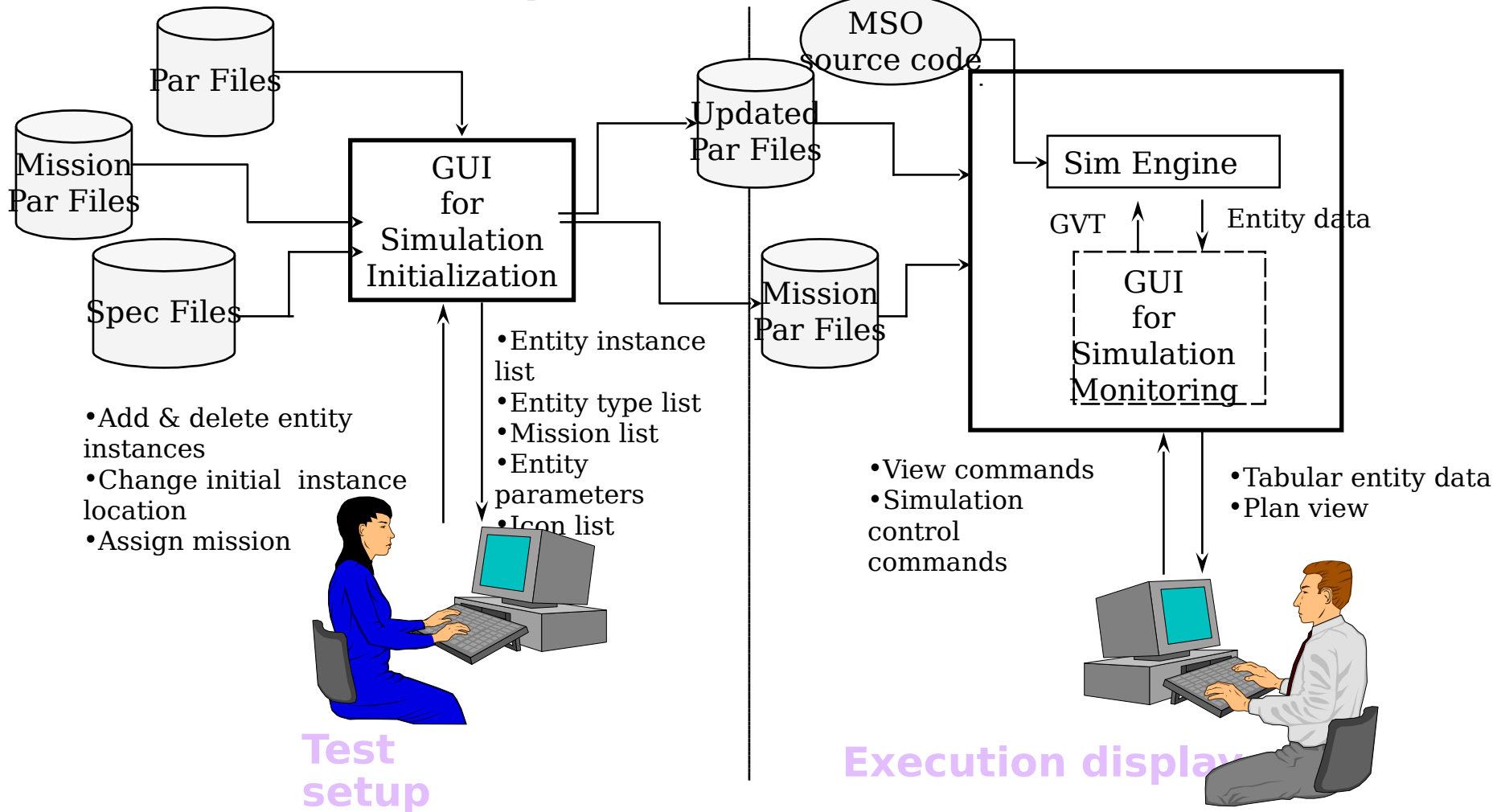
JSIMS

- Integrated with SPEEDES sim engine
- Built infrastructure based on the Military Modeling Framework (MMF) design
- Created models via composition rather than inheritance
- Developed & integrated behavior models
- Developed Graphical Developers Toolkit (GDT)

Prototype Overview

JSIMS

Graphical Developers Toolkit



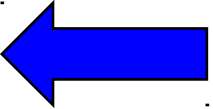
Results

JSIMS

- Incorporated MSO component design into Build 1
 - composition
 - initialization
- Incorporated design of Aircraft behaviors into Build 1
 - Finite State Machine (FSM) designs for task level behavior
 - FSMs chained to produce mission level behavior
 - Missions linked to MSOs through “Tactics” component
- Design concepts for cascading effects incorporated into Build Civil Environment model
- Adapting behavior designs for Build 2 Organizations
- Adapting GDT for unit and category testing

Agenda

JSIMS

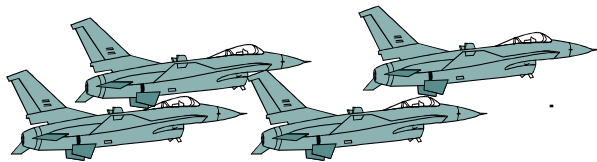
- Background
- System concept
- Schedule
- Demonstration description
- Demonstration 
- Q&A

Demonstration Overview

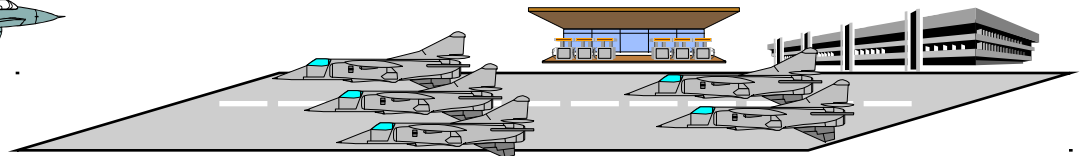
JSIMS

- You will see:
- 3 mission related demonstrations
 - Laser guided missile
 - Combat Air Patrol (CAP) Mission
 - Airbase Operations with resource constraints
- Test Set-up Tool
 - Assign initial values for: location, designator, munitions, classification (friend, foe), and mission
- Execution Display

Flight & Individual Aircraft Behavior



Air Base Operations



Demonstration Highlights

JSIMS

- Composition and Initialization of MSOs
 - Unique MSOs defined in files read at run-time; no recompilation required to include new MSOs
- Behavior Types Developed
 - Route navigation & physical location
 - Target location using sensor model data
 - Four individual Aircraft fly together as flight of 4
 - Flights of Aircraft separate and perform individual actions and then regroup again
 - Perform “rules of engagement” actions - assess whether offensive action is prudent
 - Airbases launch sorties if resources such as fuel and ammunition are available
- Graphical Developers Toolkit (GDT)
 - Supports visual & tabular testing of models, sub-models, and component configurations

Connectivity Information

JSIMS

- Joe Hintz, Raytheon NASM Program Manager
 - Telephone - 978-440-1125
 - Email - hintzj@res.raytheon.com
- Bill St John, Raytheon Software IPT Lead
 - Telephone - 978-440-2552
 - Email - william_v_st_john@res.raytheon.com

Agenda

JSIMS

- Background
- System concept
- Schedule
- Demonstration description
- Demonstration
- Q&A

